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RADIUM

EDITED BY
CHARLES H. VIOL, Ph. D.
AND
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A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY PHYSICS AND THERAPEUTICS OF RADIUM AND RADIO-ACTIVE SUBSTANCES

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RADIUM

A MONTHLY JOURNAL DEVOTED TO THE CHEMISTRY, PHYSICS AND THERAPEUTICS OF RADIUM AND RADIO-ACTIVE SUBSTANCES

Edited and Published by Charles H. Viol, Ph. D., and William H. Cameron, M. D. with the assistance of collaborators working in the fields of Radiochemistry, Radioactivity and Radiumtherapy.

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VOL XV SEPTEMBER, 1920 No. 6

A REPORT OF THE WORK CARRIED OUT AT THE RADIUM INSTITUTE, LONDON,

FROM JANUARY 1ST, 1919, TO DECEMBER 31ST, 1919

By

A. E. HAYWARD PINCH, F. R. C. S.,

MEDICAL SUPERINTENDENT

PART II. THE TREATMENT OF DISEASE

Malignant Conditions

When subjected to the action of radium rays carcinomatous and sarcomatous cells respond in a different fashion to those of normal healthy tissues. They are more easily stimulated, their vitality is more quickly inhibited, and degeneration occurs at a more rapid rate. The fundamental principle underlying all radium therapy is the correct estimation of the dosage and exposure necessary to bring about the death of pathological cells, without appreciably affecting the functions and vitality of the normal ones, and so enabling repair to be accomplished satisfactorily.

An insufficient dose may, and often does, act only as a stimulus, causing increased growth; on the other hand, an over-dose may result in the destruction of normal tissues, leading to the formation of fistulae, or the development of intractable ulceration.

Malignant growths vary somewhat in their susceptibility to radium according to their nature, epiblastic, hypoblastic or mesoblastic.

Adopting the formula $D = Q \times T$.

D being dosage expressed in milligramme-hours,

Q being amount of radium bromide in milligrammes, *

*IMPORTANT—It must be recalled that dosage in this Report is expressed in terms of crystalline radium bromide, the radium element content of which is 53.6 per cent. To express dosage in terms of milligrams of radium element, the unit used in the United States, it is necessary to multiply the figures given in this Report by the factor 0.536 or for an approximate figure, divide by two.—Ed.

T being length of exposure in hours,
and speaking in very general terms, epiblastic growths appear to be more favorably influenced when Q is relatively low and T high; hypoblastic growths when Q is relatively high and T low; whilst mesoblastic growths occupy an intermediatte position.

(a) An epiblastic growth,
(b) A hypoblastic growth,
(c) A mesoblastic growth,

the best results would probably be obtained in the following fashion:—

	D	=	Q	×	T
(A)	3,000	=	50	×	60
(B)	3,000	=	150	×	20
(C)	3,000	=	100	×	30

In considering the results obtained in the treatment of malignant disease, emphasis must be laid upon the fact that—with the exception of rodent ulcer—no operable cases of malignant disease are treated at the Radium Institute, save in the few instances where the patients have positively refused operation.

In at least 70 per cent of these cases which are treated the disease is very far advanced, and extensive dissemination is present, conditions which render it impossible to entertain any hope of effecting an "apparent cure." Arrest of the progress of the disease, with relief of the attendant symptoms, is the utmost that reasonably can be expected.

CARCINOMA OF THE BREAST. Dealing with the cases of malignant disease presenting themselves for treatment, in the order of the frequency of their occurrence (rodent ulcer being excepted) carcinoma of the breast occupies the first place, and comprises from 20 to 25 per cent. of all cases.

Every variety of this condition is met with, from the rapidly growing encephaloid type, with extensive lymphatic involvement; to the localized hard atrophic tumour which may have existed for two or three years without occasioning the patient any pain or discomfort.

The prognosis is invariably bad in cases of the former character, more especially when the disease occurs, as it so frequently does, in young women of corpulent habit; and but little real benefit is to be expected from the use of radium, though prolonged screened exposures to the periphery of the growth may occasionally retard the progress of the disease to some slight extent.

The atrophic type usually responds very favorably to prolonged screened exposures, the treatment powerfully reinforcing nature's attempts at the production of a curative fibrosis, causing a still greater atrophy and encapsulation of the growth, and preventing permeation of the lymphatics.

Between these two extremes—encephaloid and atrophic cancer—all modifications occur, and the prognosis depends to a very great extent upon the history and clinical features, but treatment should be conducted with the object of increasing the development of fibrous tissue, and so constricting the carcinomatous alveoli, causing degeneration of their contents, and arresting their dissemination by the lymphatics.

When the overlying skin is implicated and ulceration has taken place, healing of the surface may often be induced by exposures of twelve to eighteen hours' duration with "half strength" applicators, screened with 1 mm. of silver.

Small isolated subcutaneous nodules attached to muscles, ribs, clavicle or sternum, are best treated by the insertion of an emanation tube of appropriate size, screened with 1 mm. of silver, for between eighteen and twenty-four hours, the length of exposure being dependent upon the initial activity of the apparatus.

In dealing with metastatic deposits in the liver, lungs, stomach, scalp and long bones, prolonged screened exposures are called for; these serve to arrest the progress of the disease, and sometimes cause an actual decrease in the size of the secondary foci.

CARCINOMA OF THE UTERUS. It is but seldom that patients suffering from this condition present themselves for treatment at the Radium Institute before the disease has existed for so long a period and dissemination is so far advanced, that but little hope of effecting even an "apparent cure" can be entertained. A few "border-line" cases are sent from time to time, and in these instances it appears justifiable to submit the patient to a course of radium irradiation, as this will not infrequently so lessen the amount of existing induration, and diminish the fixation of the uterus, that its removal can be more completely and satisfactorily accomplished.

It has hitherto been the practice at the Radium Institute strongly to urge immediate operation in cases where such a measure is practicable, but radium treatment appears to exert such a very beneficial effect upon early cases of carcinoma of the cervix, that if the patient exhibit any great reluctance to operative interference, the latter method of treatment may be adopted.

In cases which are manifestly inoperable the systematic improvement which almost invariably follows upon radium treatment is most striking, and far exceeds that of any other therapeutic measures. Arrest of haemorrhage, lessening of discharge, healing of ulceration, reduction of surrounding infiltration, diminution of the rate of growth, and amelioration of pain are constantly observed, and though the susceptibility of patients varies within very wide limits, some responding much more speedily and completely than others, yet in nearly every instance definite benefit results, and the progress of the disease is greatly retarded.

Several factors must be taken into account when attempting to form a prognosis in the radium treatment of uterine cancer. The disease usually runs a slower course, and dissemination into the pelvic glands is much less active in patients who have passed the climacteric than in those in whom the menopause has not been established. Very young and very corpulent patients also do badly, though this rule is not without its exceptions.

The cases in which the best results may be anticipated are those in which the patients are of fifty years of age and upwards, where there is but little fungation, the vesico-vaginal and recto-vaginal septa are not much involved, and there is no very great amount of peri-uterine induration present. In these instances definite arrest of the progress of the disease is sometimes obtained, the patient remaining apparently well for three, four, or more years. It is not, however, correct to speak of these cases as "cured," as there is always the probability that sooner or later evidence of dissemination will occur, and the disease will be found to be affecting regions far beyond the effective range of radium.

Recurrences in the vaginal wall, occurring after the operation of hysterectomy, if taken at an early date, often do surprisingly well; their complete disappearance is occasionally brought about, and no recurrences take place.

When the uterus is very firmly fixed, the patient complaining of sacral and pelvic pain, radiating into both thighs, infection of the pelvic glands and deep parametric tissues may be regarded as certain, and radium is able to do but little for these patients, beyond possibly arresting the disease, and slightly diminishing the pain.

When treating cases of cervical carcinoma, if the growth be of the cauliflower or fungating type, the removal of as much of the mass as possible, by excision or curetting before the treatment is commenced, is to be advocated. A tube containing not less than a 100 mgr. of radium should be employed, the screening should be either 1 mm. of silver or 2 mm. of lead, according to whether the apparatus can be inserted actually within the cervical canal, or has to be placed in the vagina in contact with the diseased surface.

The uterine tissues appear to have a greater power of resistance to the radium rays than have the vaginal ones, and the employment of a silver screen in contact with the vaginal wall for a period of more than eighteen hours may quite possibly lead to the formation of a fistula, but with the tube inserted within the cervical canal this contingency does not arise. The exposure should be between twenty and twenty-four hours' duration, and may advantageously be supplemented by the use of a plate containing 100 or more mgrs. of radium screened with 2 mm. of lead, and applied externally over the fundus. By this means a thorough radiation of the whole diseased area is obtained. The exposures should be repeated at intervals of not less than six weeks.

Circumscribed and indurated nodules of small size in the substance of the cervix may receive, in addition, treatment by the insertion into their substance of tiny emanation tubes of 20 to 30 mgrs. initial activity, screened with 0.3 mm. of platinum, for from twelve to eighteen hours.

Carcinoma of the Body of the Uterus. This condition is of much less frequent occurrence than cancer of the cervix, and since prognosis as regards recurrence after hysterectomy is very favorable, operation should always be resorted to if practicable.

If radium treatment be determined upon, a tube of not less than a 100 mgrs., screened with 1 mm. of silver, should be inserted into the uterine cavity, supplemented if possible with a plate of equal strength, screened with 2 mm. of lead, and applied over the fundus. Great caution must be observed in making the intrauterine application, the uterine walls being extremely friable when infiltrated with carcinoma and readily perforated if undue force be used.

Carcinoma of the Tongue, Palate, Buccal and Pharyngeal Mucous Membranes. These cases form an important, but peculiarly distressing group, by far the greater number presenting themselves after all surgical measures have been exhausted, the recurrences being wide spread and productive of constant and severe neuralgic pain. In many patients the tongue, or what remains of it, is indurated and fixed, there is infiltration of the floor of the mouth, and deeply excavating ulceration, which is exquisitely tender to the touch. Mastication is impossible, dysphagia is pronounced, and the patients can only take a liquid diet. Lymphatic infection is wide-spread, with limitation of movements of head and neck. There is anaemia, and general mal-nutrition.

Taken as a whole, these conditions prove very refractory to radium treatment, and the results are disappointing. For the purpose of prognosis it appears justifiable to divide them into two chief groups:—

(1) Those in which acute ulceration predominates.

(2) Those in which induration predominates.

The former class do very badly, and radium has but very little effect on them, though occasionally exposures of one to two hours' duration to tube apparatus, screened with 1 mm. of silver, applied in contact with the ulcerated surface on jaw or tongue on four or five successive days, will tend to arrest the ulceration, and sometimes induce a very transient repair.

The latter are more amenable, and when the induration is circumscribed, or forms small non-ulcerated nodules in the tongue, on the floor of mouth, palate or jaws, the actual insertion of a tiny powerful emanation tube, screened with 0.3 of platinum for five to six hours, will bring about their disappearance. Even in these instances, however, the probability of lymphatic infection appearing sooner or later must never be ignored, and radiation of the cervical and sub-mental glands should be carried out as a matter of routine and a prophylactic measure.

A variety of epithelioma occasionally met with on the buccal mucous membrane is the exuberant papillated growth with but little submucous invasion. These lesions, if treated at an early stage by the burying of powerful emanation tubes, often clear up completely and seldom recur.

When lymphatic infection is of long standing, and masses of fixed, enlarged, indurated glands are present in the cervical or submental regions, prolonged exposures with heavily screened apparatus are often of considerable use in diminishing the size of the infected glands, preventing implication of the skin covering them, and the appearance of ulceration.

Some patients experience distinct relief of their neuralgic pains after prolonged irradiation, but unfortunately this effect is not constant and cannot be assured in any particular case.

CARCINOMA OF THE RECTUM. The susceptibility of healthy rectal mucous membrane to radium rays often proves a very troublesome phenomenon when treating malignant disease of the rectum. Men appear to be more readily affected than women, and, in addition, personal idiosyncrasy is often clearly evident, rendering it impossible to predict the nature of the reaction in any one instance.

The growth which do best are those of an annular type, vascular and exuberant in character, and situate at the upper half of the rectal ampulla. In the treatment of these, if the radium tube be placed within the lumen of the growth, it does not come into contact with any normal mucous membrane, and no proctitis is set up. The plaque-like infiltrating lesion affecting only a portion of the circumference of the canal is not very favorably influenced, and although something may be done to protect the unaffected portions of the wall from the radium rays, by gauze packing and lead rubber screening, some degree of proctitis generally occurs.

If extensive ulceration be present, even though the danger of obstruction may seem remote, the patient should be advised to submit to the performance of colostomy before radium treatment is undertaken, as the passage of faeces over an ulcerated surface, the tenderness of which has been intensified by a radium reaction, is productive of very severe pain.

The routine treatment of cases of rectal carcinoma consists in the introduction into the lumen of the growth—if such exist—or the placing in accurate apposition with the affected area, of a tube of 100 to 200 mgrs., screened with 2 mm. of lead, and giving an exposure of from

fifteen to thirty hours' duration according to the strength of the tube. The dosage should not exceed 3,000 mgrs. hours, and the exposure should not be repeated at an interval of less than two months.

Special care should be taken to protect the healthy mucous membrane as far as possible from the radium rays.

During the past twelve months several cases of rectal carcinoma have received injections of cuprase between their successive exposures, 5 c.c. of the solution being injected intramuscularly every fourth day, until a total of 60 c.c. has been administered. It is not yet possible to make a positive pronouncement on the matter, but the results hitherto noted justify a continuance of this combined treatment.

Rodent Ulcer. It is in this variety of malignant disease that by far the most striking and remarkable results are obtainde. It is now quite justifiable to adopt radium therapy in preference to any other method of treatment when dealing with an untreated rodent ulcer of comparatively recent origin. The case sheets of the Radium Institute contain numerous records of patients who received only one exposure six, seven, or eight years ago, and who have remained ever since the date of their treatment entirely free from any recurrence.

Lesions not exceeding 3 cm in diameter, and not affecting bone, cartilage, or mucous membrane, can almost invariably be removed by one application of from one and a half to three hours' duration, with a "full strength" applicator, unscreened.

It is of the utmost importance, however, to treat well beyond the border of the lesion, as appreciable either by sight or touch, as when recurrence does take place it generally occurs at the margins of the scar.

The length of the exposure must be carefully calculated, due note being taken of the clinical characters of the growth—hypertrophic or ulcerative — and the amount of circumjacent or subjacent induration which is present. The hypertrophic type will take a much larger dose than the ulcerative type, but the results are more satisfactory.

When dealing with the strongly ulcerative class of lesion special attention should be paid to its borders, and it is often advisable to give the edges a longer exposure than the base—say, twenty to thirty minutes more.

When treating rodent ulcers in the neighborhood of the orbital cavity, patients should be warned that the resultant reaction may produce some alarming oedema of the loose cellular tissue of the eyelids, producing partial or complete occlusion of the palpebral opening for a few days. This engorgement, however, proves quite transient, and passes off in two or three days' time.

When rodent ulcers affect the palpebral mucosa the disease can usually be eradicated by radium treatment, but when the ocular conjunctiva is attacked, the prognosis is not nearly so good, and if the sclerotic become definitely affected, the prospects of "cure" are extremely remote.

Rodent ulcers that have been subjected previously to repeated treatment with caustics, scraping, CO_2 or X-rays, need to be treated with great caution, as the avascularised and devitalised conditions of the tissues seriously interferes with proper repair, and unless the exposure be very carefully calculated, a destructive reaction, far exceeding that which was hoped for, occurs. It is often better in dealing with this class of case to depart from the routine procedure of inducing a destructive reaction by the use of a "full-strength" applicator, and to re-

sort instead to prolonged exposures of twenty-four or thirty hours' duration, with half-strength applicators, screened, with 2 mm. of lead. This method of treatment should invariably be adopted in those distressing cases (now happily becoming very rare) which have existed for ten, fifteen or twenty years, have destroyed the greater portion of the face, and invaded its cartilaginous and bony tissues. "Cure" in these cases is impossible, but a very great deal can be done to arrest the progress of the disease, lessen the foul discharge, and render the patient much more comfortable.

Radium appears to have absolutely no power to cure a rodent ulcer when it has once invaded the bony tissues, and for this reason affected portions of bone should be excised before radium treatment is commenced.

Carcinoma of the Bladder. The treatment of inoperable carcinoma of the bladder is sometimes productive of extremely good results, more especially when the disease occurs in females, as the introduction of radium into the bladder via the uretha is much more easily and satisfactorily accomplished than in males; and further, it is possible to reinforce the action of the radium tube in the bladder by that of a screened tube applied per vaginam, and brought into apposition with the trigone.

By the employment of this combined method the healing of ulceration, diminution in size of the growth, lessening of induration, and arrest of the progress of the disease can be brought about, and the amount of improvement accurately determined by cystoscopy and digital examination.

A few cases of epithelioma of the female uretha have also been treated by the combined method with very gratifying results, the growth disappearing, and the patient's discomfort and distress during micturition being completely abolished.

Carcinoma of the Prostrate. When the disease is localized to one lobe, and the enlargement of the gland is not very great, the actual burying of a silver screened radium tube within the carcinomatous mass should be adopted. If, however, the patient be averse to this procedure, an alternative method may be tried. A tube of about 100 mgrs. activity, screened with 1mm. of silver, is placed in the penultimate section of a bicoude catheter, which is introduced into the uretha, and allowed to remain in its prostatic portion for two hours a day on five successive days. This is supplemented with an exposure of from twenty to thirty hours' duration with a plate of about equal strength, screened with 2 mm. of lead, and applied over the perineum, and, further, if the patient be willing to run the risk of some slight degree of proctitis, a tube of 100 mgr. strength, screened with 2 mm. of lead, may be applied per rectum, in contact with the base of the prostate for five or six hours on each of three successive days. By the adoption of these measures very definite improvement is often obtained, and the patient's life prolonged for perhaps two or three years.

Carcinoma of the Oesophagus. Definite, though unfortunately only temporary, relief may sometimes be obtained by the use of radium in the treatment of this disease, but as the technique calls for the employment of direct oesophagoscopy, treatment should only be entrusted to the hands of a skilled laryngologist.

A powerful emanation tube of not less than a 100 mgrs. activity, screened with 1 mm. of silver, should be employed, the position of the

growth demonstrated with the œsophagoscope, and the radium tube, mounted on a long rubber-covered pliable silver wire, passed down the œsophagoscope into the stricture. The œsophagoscope is withdrawn, the pliable silver wire moulded to the arch of the palate, and its free extremity fastened to the cheek with strapping and a bandage. The exposure should be from fifteen to twenty hours' duration, according to the character of the lesion.

The immediate effect of the treatment is usually some improvement in the power of swallowing, but this is quite transient, and is due entirely to the mechanical effect of dilatation by the tube. In about a week's time the reaction sets in, and the accompanying congestion tends to occlude the stricture, making the dysphagia more pronounced. With the subsidence of the reaction, however, some absorption of the growth occurs, thus rendering the stricture more patent, and enabling the patient to swallow food with comparative ease for a period of three, four, or six months (or in favorable cases even longer), when treatment will have to be repeated. No case of "cure" has so far been recorded, but in some instances improvement has been maintained over a period of from fifteen months to two years.

Carcinoma of the Stomach and Intestines. Cases which are inoperable, or in which recurrence has taken place after operation, occasionally present themselves at the Radium Institute for treatment. Prolonged exposures with heavily screened powerful applicators sometimes prove of considerable value in diminishing the pain and arresting the progress of the disease, but this is the utmost that can be looked for. Attempts have been made to treat carcinomata affecting the mucosa of the stomach by means of an emanation tube screened with 1 mm. of silver, and attached to a long silken thread. The tube is swallowed by the patient, and its position in the stomach determined from time to time by examination with the X-ray screen. Some diminution in the amount of the gastric haemorrhage has followed upon this treatment in one or two cases, but the number thus treated is at present too small to permit of an authoritative statement on the subject.

Sarcomata. These tumors exhibit many variations in the microscopical characters of their cells, and their response to radium therapy also differs to a considerable extent.

The periosteal usually respond better than the endosteal varieties, and the class of growth formerly termed myeloid sarcoma, but more recently named myeloma, acts in a somewhat bewildering fashion; about 50 per cent. of myelomata are not affected at all by radium treatment, and in the other 50 per cent. the result is gratifying. It is hard to say why this should be so, and the microscopical examination of the contained cells has so far afforded no information in the matter.

It is a fact well worthy of note that periosteal sarcomata which do respond to radium treatment appear to have their malignancy destroyed, and the tendency to recurrence or dissemination is very greatly inhibited, the patients remaining "apparently cured" for many years.

From the point of prognosis the "spindle-celled" varieties are to be preferred. The small "round-celled" is not so favorably affected, whilst the large "round-celled" appears to occupy an intermediate position.

With regard to the melanotic sarcomata, disappearance of the primary growth may often be brought about, and the progress of the disease temporarily arrested. In some cases so long a period of time may elapse as to excite false hopes in the patient and his medical at-

tendants. Radium treatment, however, appears powerless to prevent the ultimate dissemination of the disease, and after a varying period, evidence of metastases in distant parts of the body makes its appearance, and the disease rapidly progresses to a fatal termination.

Sarcomata affecting the naso-pharynx are extremely susceptible to radium, and often completely disappear within a month of the treatment. The lympho-sarcomata attacking the cervical and mediastinal glands usually show a very rapid and pronounced improvement, the improvement persisting for four or six months. In most cases some recrudescence of the condition is then noted, necessitating further exposures, which may have to be repeated at prolonged intervals for three or four years. A time is, however, ultimately reached when the response to radium treatment becomes negligible, and the disease then rapidly assumes the mastery.

When treating sarcomata it is imperative to give a massive dosage, and whenever practicable, the actual burying of silver screened tubes within the center of the mass, supplemented by the external application of powerful applicators, screened with 2 mm. of lead, should be adopted. The rapid diminution in the size of growths thus treated is productive of a very definite auto-toxaemia, with languor, nausea, and a rise of temperature. This, however, proves transient, and rapidly disappears if the patient be kept at rest, and laxatives and diuretics judiciously employed.

Endothelioma. This class of growth is most frequently met with as a tumor of the parotid gland, and when operation is impracticable radium treatment often proves of great value, the growths being much reduced in size, and their progress arrested. It is best, however, to subject these tumors to prolonged radiation with heavily screened apparatus applied externally, and not at first to attempt treatment by the actual insertion of a screened tube into their substance. If any actively secreting portion of the parotid gland be in contact with the tube track there is always the possibility that a sinus may form at the spot where the tube is inserted. The sinus is kept open by the action of the parotid secretion, and a slow progressive ulceration starts which defies all efforts of repair.

If, however, the growth be a recurrent one, all parotid substance having been removed at the previous operation, the burying of radium tubes may be resorted to safely.

Another favorite site for the development of this class of tumor is the neighborhood of the carotid body, and in these instances the use both of buried tubes and external applicators is to be advocated; the results are frequently most gratifying.

NON-MALIGNANT CONDITIONS

Uterine Fibroids The systematic relief which follows upon the treatment of this condition with radium is usually very definite and striking. The metrorrhagia first disappears, then the menorrhagia is checked, and finally the flow returns to normal, although in some instances amenorrhoea occurs and persists for three, four, or even more months. Some diminution in the size of the tumor generally takes place also, though the reduction may not be very great.

The treatment is best carried out by the introduction of a 100 mgrs. tube, screened with 2 mm. of lead, inserted into the uterine cavity, or failing this into the posterior vaginal fornix. Applicators containing

from 100 to 200 mgrs. of radium, screened in similar fashion, should be applied externally above the pubes, over the enlarged uterus. The total exposure should be from twenty-four to thirty hours' duration. In some cases the immediate effect of this treatment is an increase of the amount lost at the next period, but with successive periods there is a steadily progressive diminution. Treatment of these cases should be repeated at intervals of not less than three to four months, and if the exposures have to be given on three or four occasions the probability of premature induction of the menopause must be made clear to the patient.

Chronic Metritis. This peculiarly intractable condition, which so often defies all measures short of surgical interference, often responds in the most gratifying fashion to radium therapy, and the operation of hysterectomy is averted. The treatment is identical to that adopted for uterine fibroids, and the same caution with regard to the premature establishment of the menopause must be observed.

Naevi. *Cavernous Naevi.*—The results obtained in the treatment of cavernous nævi are excellent, especially if the infant be brought at the earliest possible date, and no other treatment such as CO_2 snow, cauterization, or electric needling has been adopted. Considerable patience must, however, be exercised to bring about a thoroughly satisfactory result, and any undue impatience on the part of the parents must be firmly dealt with.

"Half strength" applicators, screened with 0.1 mm. of lead should be employed, and the lesion subjected to a cross-fire radiation. The length of exposure should vary from thirty minutes to an hour, three exposures of this duration being given on three successive days, and the series repeated at intervals of about six weeks.

With this method a slow but steadily progressive diminution in the size of the lesion is obtained, and no vesication or scarring of the skin results. When once a cure has been effected there appears to be no tendency to any recurrence of the trouble.

Capillary Naevi.—These are very much more troublesome, and vary very greatly in their behavior. A preliminary diascopy should be performed before treatment is commenced. If complete blanching can be obtained by a moderate degree of pressure the result will probably be good, but if this be not so, nothing more than some diminution in the intensity of the color is likely to be obtained. Personal idiosyncrasy in these cases is very great, and for this reason it is necessary to proceed with the utmost caution. An exposure not exceeding fifteen minutes' duration with a "half strength" applicator is given, attempt being made to procure just the amount of reaction which will produce a definite erythema with desquamation, but not vesication; and when once the exact time of this exposure has been accurately ascertained, such exposures should be repeated at six-weekly intervals, until the skin has assumed a salmon-pink tint. Screens of 0.1 mm. of lead should be used on subsequent occasions, and exposures increased to one or one and a half hours' duration.

In spite of all these precautions, however, the tendency to the appearance at a later stage of telangiectasis or pigmentation must always be borne in mind, and for this reason the child should be inspected at fairly frequent intervals for some time to come, so that any appearance of these sequelæ may be dealt with promptly.

Corns, Warts, Papillomata and Keratomata. The majority of

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these lesions can generally be removed by short exposures of one to one and a half hour's duration, according to the size and thickness of the growth, with "full strength" applicators, unscreened. If the dosage be correctly calculated, exfoliation of the growth, with but little accompanying inflammation, occurs in from three to four weeks' time, and tendency to recurrence is but slight.

KELOIDS AND VICIOUS CICATRICES. Radium treatment is greatly to be preferred to surgical interference in these cases, as it generally effects a very improvement in the condition, if it does not bring about the complete disappearance of the lesion.

"Half strength" applicators, screened with 1 mm. of silver, appear to be the most effective. The exposure should be of six hours' duration on three successive days, eighteen hours in all, and should be repeated as necessary at six-weekly intervals. With this method a gradual absorption of the keloidal tissue takes place, tenderness and irritability disappear, and the skin resumes its normal appearance.

It is important to treat these keloids as soon as possible after their appearance, as those which have existed for two, three, or more years sometimes prove refractory, and their disappearance can only be brought about by the employment of a destructive reaction which will leave a depressed white scar.

LUPUS ERYTHEMATOSUS. This obstinate and extremely disfiguring disease, which so often resists all forms of treatment, both general and local, is frequently very greatly improved by radium therapy, though it is not justifiable to speak of "cure," as recurrences tend to take place after varying intervals of time. "Half strength" applicators, unscreened, or screened with 0.01 mm. of aluminum, should be employed, and should be of sufficient size to reach well beyond the margins of the lesions. The exposures should be of from thirty to sixty minutes' duration, according to the amount of hyperaemia and infiltration present, and should be repeated at intervals of from four to six weeks.

ually to be preferred to radium in the treatment of cases of lupus vul-

TUBERCULOSIS. (*a*) *Lupus Vulgaris of Skin.* Finsen light is usually to be preferred to radium in the treatment of cases of lupus vulgaris. When patients show themselves refractory to the former method of treatment the latter will not infrequently give excellent results. Both screened and unscreened applicators are usually necessary, the latter when dealing with ulcerated, and the former when treating indurated areas. Silver screens, 0.2 mm. in thickness are sometimes of value in the treatment of superficial ulcerated lesions, "half strength" applicators are employed, the length of the exposure being from two or three hours.

In lesions of long standing, with much dense infiltration and distinct "apple jelly" nodules, prolonged treatment with screens of 2 mm. of lead should be adopted as a matter of routine.

Cases in which the disease affects the mucous membrane of the nose seem particularly suitable for radium therapy, the position being one in which the satisfactory use of Finsen light is impossible. Tubes of 25 or 50 mgrs. screened with 1 mm. of silver, are applied inside the nose, in actual contact with the diseased surface, this is supplemented with a "full strength" applicator, screened with 2 mm. of lead, and applied over the exterior of the nose. An exposure of six hours' duration is given, and repeated, if necessary, after an interval of six weeks.

(*b*) *Lupus Vulgaris of the Palate and Fauces* may often be greatly improved by radium, but as the patients are unable to tolerate the pres-

ence of an applicator in the mouth for any considerable time, "full strength" unscreened apparatus is used, and exposures of between thirty and sixty minutes' duration given. A fairly vigorous reaction is produced, which is generally followed by the development of healthy scar tissue, and the arrest of the progress of the disease.

(*c*) *Tuberculous Adenitis.* As many patients are strongly opposed to operation when the glands in the cervical triangles are afferted, by reason of the scarring which must inevitably occur, the employment of radium treatment as an alternative is to be recommended; and if adopted in an early stage of the disease, before numerous glands are affected and caseation has occurred, favorable results may be anticipated with some degree of confidence. Prolonged exposures with heavily screened applicators should be employed, especial care being taken to eliminate all chance of irritation from the "secondary excited" rays, as pigmentation appears to be particularly prone to occur in these patients.

As a result of the exposure the glands become very much smaller, and in many cases the disease is arrested by an encapsulating fibrosis.

Exophthalmic Goitre. In the comparatively early stages of this disease, and before profound nutritional changes are apparent, the employment of radium therapy as an adjunct to the routine medical treatment is strongly to be advocated. In the majority of instances a definite decrease in the size of the thyroid, with striking symptomatic improvement results. Prolonged screened treatment with 200 or 300 mgrs. of radium is called for, and the patient's medical attendants should be warned that the first effect of the treatment may quite possibly be an exacerbation of all the symptoms, lasting perhaps for two or three weeks. This phenomenon is undoubtedly occasioned by the radium reaction producing an increased influx of the thyroid secretion into the blood stream; the disturbance, however, gradually passes off, and definite improvement slowly manifests itself. In very susceptible patients one series of exposures may be all that is required, in others, treatment may have to be repeated at intervals of three or four months. In very advanced cases, associated with extreme tachycardia, great wasting, frequent vomiting or diarrhoea, results are not nearly so good. The treatment has to be undertaken with great caution, and the effects carefully watched, as if the dosage be at all excessive, harm may result.

Leucocythaemia. (*a*) *Splenic.*—As operative measures for the treatment of this condition are steadily coming into favor, and radium irradition has been found to exercise a very rapid and definite effect upon the size of the spleen, it is now advisable to subject patients suffering from splenic leucocythaemia to this form of treatment, before the operation of splenectomy be performed. A large quantity of radium, 400 or 500 mgrs. of radium in all, should be used, with screens of 2 mm. of lead, and an exposure of twenty-four to thirty hours' duration given. This treatment is usually followed by an extremely rapid decrease in the size of the organ. Cases have been noted at the Radium Institute in which the lower border of the spleen when first seen, reached well below the level of the umbilicus, within four weeks of the treatment it had receded to the costal margin of the same side, enabling the removal of the spleen to be performed with comparative ease a few days later.

(*b*) *Lymphatic.*—This form of leukaemia is not so favorably influenced as the splenic variety, but much may be done by radium therapy to reduce the size of the affected lymphatic glands, and to improve the patients blood condition and general health. Patients need, however, to

be kept under fairly constant observation, as recrudescence of the disease invariably occurs after a few months, necessitating further exposures. So long as the condition remains confined to the cervical, axillary and inguinal glands, comparatively favorable results may be hoped for, but when once the mesenteric and pelvic glands become infected the prognosis is bad, and the patients rarely survive for more than a year.

SKIN DISEASES.

Many chronic forms of superficial skin diseases are very favorably influenced by radium therapy, notably lichenification, chronic eczema,, leucoplakia of the first degree, pruritus, and psoriasis, though the last condition exhibits a very strong tendency to recurrence, and it is extremely unusual to obtain a "cure."

"Half strength" or "quarter strength" applicators are employed either unscreened, or screened with a 0.01 mm. of aluminum, and the exposures range from three to fifteen minutes' duration, repeated at intervals of two or three weeks. The amount of relief frequently obtained in lichenification, and in the pruritus that is associated with slight degrees of hyperkeratosis, is very striking, patients often becoming completely free from the almost intolerable irritation within a few days of the exposure. Small isolated patches of chronic eczema, or of seborrhoeic eczema are often completely cured by one or two application, and the tendency to recurrence is but slight. In skin disease affecting the deeper layers of the corium and accompanied with definite infiltration —for example, xanthoma, mycosis fungoides, xerodermia pigmentosum —longer screened exposures are demanded, but it is impossible to lay down any precise rules, as so much depends upon the history, extent, and character of the lesion.

ARTHRITIS DEFORMANS.

Cases of infective arthritis of comparatively recent origin, occurring in patients under the age of forty, and accompanied by peri- rather than intra-articular changes, are often greatly benefited by the daily administration of 500 c.c. of a radium emanation solution of a strength not less than 1.5 millicuries per litre. Pain and tenderness rapidly disappear, the stiffness and rigidity of the affected joints are abolished, and the patients become able to perform finer movements of limbs which had previously been beyond their power.

When, however, the disease is monarticular in type, intra-articular in character, and accompanied by the presence of osteophytic growths, or pathological changes in the bones or cartilages, but little good is to be expected, and the solution, if adminstered, can do little beyond improving the general health, and possibly relieving pain.

I desire to express my great indebtedness to my colleague, Dr. J. E. A. Lynham, for much generous help in the compilation of this report.

The modifications of technique, and the indications as to the nature of the screening to be employed, and the length of exposures to be given in the various conditions, are the result of our join observations and experience. Much valuable information bearing on the question of prognosis has also been obtained from the case sheets of the night clinic, for the conduct of which Dr. Lynham has been responsible during the past five years.

REPORT OF THE CHEMICO-PHYSICAL LABORATORY

BY

W. L. S. ALTON, F. I. C., Director.

The appointment of Mr. J. F. Clarke, M.Sc., in June to a post on the Laboratory Staff has relieved to some extent the pressure of work occurring during the period of the war, and has permitted the resumption of investigations into the application of radium for therapeutic purposes.

	1919	1918
Number of emanation tubes and applicators prepared =	771	789
Activity of above in terms of Radium Bromide =	66.04 grammes.	62.47 grammes.

It will be noticed that the total activity is considerably greater, though the number of tubes is smaller than in 1918. This is due to the apparent tendency to use stronger applicators than formerly, for the average value was 86 mgrs., and the lowest 18 mgrs., whereas tubes of 5 to 10 mgrs. were frequently used in former years.

The strongest factor in the use of emanation as a source of radiation is the diversity of applicators which can be prepared at a few hours' notice, to supplement the fixed salt applicators which are the standard equipment of the Institute. Inasmuch as a curie of emanation (the amount of emanation in equilibrium with a gramme of metallic radium) occupies only 0.58 cubic millimetres, it will be seen that the relative space taken up by emanation and by the various salts of radium differs very widely.

In the preparation of emanation applicators the worker is exposed to radiation the precise effect of which it is difficult to foresee; certain precautions can, however, be taken by all members of a laboratory staff who have to deal with emanation, and experience gained at the Institute may be useful to others.

In the first place it is considered inadvisable to breathe air diluted with emanation, however dilute the mixture; and as accidents such as the breakage of an emanation tube occasionally occure, it is imperative to have a powerful fan in the ceiling of the laboratory, and ventilators on the floor level, so that the air may be rapidly and completely changed.

Secondly, it has been noticed that any mercury from pumps, gas collecting tubes, etc., which has been in contact with emanation, becomes coated with a film of oxides, more especially if the mercury contains traces of other metals, as is frequently the case. This film is always strongly radio-active, due presumably to the active deposit from the emanation, and if rubber gloves are not systematically worn when carrying out manipulations with mercury, the hands of the operator will suffer in consequence.

Thirdly, distance is the best precaution; all tubes, applicators, preparations containing radium, etc., should always be put, when not in actual use, in a thick lead box, and removed to the greatest possible distance from any room containing human beings; a safe in the basement, failing that a room not in general occupation may best be adapted to this use.

If these precautions be taken the preparation of emanation applicators should not involve any great risk to the worker, for most of the operations do not take up much time, and the applicator can be dealt with before it has had time to reach its full activity; its screen can be

fitted, and the tube measured one hour after its preparation, due allowance being made for the thickness of material of the screen and the age of the emanation.

Forceps must always be used both for the screen and for the applicator, and should be as long as efficiency will permit.

A comparison of the various salts of radium procurable for making applicators or tubes has shown that only one of them, the sulphate, is capable of giving efficient and permanent apparatus. The radium content of these salts is as follows:—

	Per cent.
Hydrated radium bromide, $Ra\,Br_2\,2H_2O$	53.6
Anhydrous radium bromide, $Ra\,Br_2$	58.6
Hydrated radium chloride, $Ra\,Cl_2\,2H_2O$	67.9
Anhydrous radium chloride, $Ra\,Cl_2$	76.1
Radium sulphate, $Ra\,SO_4$	70.2
Radium carbonate, $Ra\,CO_3$	79.0

and it would appear probable that the carbonate, on account of its high concentration of radium element, would be the most suitable. Radium carbonate is a very bulky product, rather like magnesium carbonate in its properties; it adheres very firmly to anything used in manipulating it, and packs very badly in capillary glass tubes. Both the chloride and the bromide attract moisture, possibly on account of traces and impurities, and an applicator was recently seen of the old fashioned mica-fronted type, from which most of the radium had vanished because of this reason.

Further, the explosion of tubes containing radium salts is considered attributable to the incomplete dehydration of the salt, the consequent generation of electrolytytic gas often producing a pressure of several atmospheres.

Mr. Clarke has carried out measurements to determine the amount of secondary radiation emitted by the compound lead-aluminum screens mentioned in last year's report. He has found that the secondary radiation produced by lead screens is completely absorbed by 0.2 mm. of aluminum. Clinical evidence tends to show that there is a very soft secondary radiation of such short range that it is not detected by ordinary electroscopic methods, and experiments are being instituted to examine this point.

He is also associated with Dr. Mottram in a paper on "The Leucocytic Blood Content of those handling Radium for Therapeutic Purposes" read before the Electro-Therapeutic Section of the Royal Society of Medicine.

I desire to express my indebtedness to Mr. J. F. Holding for his assistance in the laboratory during the period of the war. He undertook and carried out work in connection with the evening clinic for a very long period, and was responsible for the preparation of a large number of emanation applicators.

As in former years, grants of emanation have been provided for lecture purposes, and repairs to radium apparatus belonging to many hospitals have been carried out gratuitously.

REPORT OF THE RESEARCH DEPARTMENT,

BY

J. C. MOTTRAM, M. B., D. P. H., Etc., Director.

A new Department for Research was opened in May, 1919. The

equipment has, however, been considerably delayed owing to difficulties of supply, and of obtaining suitable premises for a biological laboratory. These have now been overcome, and the biological laboratory will be available in the immediate future. In the meantime several lines of investigation have been begun, two of which can be reported upon, as the results obtained have already been read before the Royal Society of Medicine (Electro-Therapeutical Section).

The first communication dealt with the leucocytic blood content of those workers of the Institute exposed to radium. A leucopoenia (*i.e.*, diminution in the number of white cells), was found, more or less profound according to the amount of radiation to which the worker had been exposed. A reduction of the white cells to one-half was of common occurrence, and counts as low as 552 polymorphonuclear leucocytes and 706 lymphocytes per cubic millim were found. The polymorphonuclear leucocytes and the lymphocytes were effected in approximately equal amount. The effect of being away from the Institute for periods up to three months showed that the return to the normal was slow, in comparison to the rate of diminution on first being exposed to radium. Three months away from radium did not suffice for a complete return to the normal, whereas in the case of new workers, falls to one-half were observed in a month (2 cases), and in fourteen days (1 case.)

The amount of radiation which the more affected workers receive was measured and compared with the amount usually given to a patient undergoing treatment for cancer of the breast. It was found that in ten weeks the worker was subjected to this amount of radiation. As a result of this investigation further devices have been installed for the better protection of workers, and also some of their work has been given to casual workers, who are changed at frequent intervals (three months), so as to avoid any possible dangers to health. It may be mentioned that although no condition of ill health can be attributed to the leucopoenia found in the workers nevertheless this possibility cannot be overlooked.

A similar paper is being prepared, dealing with the red cell content of the blood.

The second communication to the Royal Society of Medicine was on "The Examination of Patients in Ultra-Violet Radiation." This method is the application to medicine of a war invention of Prof. R. W. Wood, of Baltimore University. Prof. Wood produced a glass, which, whilst allowing ultra-violet radiation to pass, in opaque to light. Using an arc lamp, such as a mercury vapor lamp, one is thus able to obtain a beam of ultra-violet radiation. On examining patients in the beam a number of striking appearances are seen. Briefly, the skin is seen to glow with a violet light; but certain areas, especially on the face, are not fluorescent, and appear as black spots. This spotty appearance varies much, some individuals are almost free from spots, whilst others are thickly covered. Similar differences are to be seen in photographs taken in a particular manner with an arc lamp, and it has been observed at the Institute that patients showing a spotty appearance in these photographs are more susceptible to radium radiation than the relatively unspotted. As the spots in the two cases (*i.e.*, photographically obtained and seen in ultra-violet illumination) are almost certainly the same, it follows that examination in ultra-violet radiation will probably give the radiologist a means of at once estimating the susceptibility of his patient.

Other striking appearances are seen besides the dark spots. Scat-

tered over the face are numerous minute brightly fluorescent spots, having the appearance of stars. The teeth are very brilliantly fluorescent, less so the nails. The eyes may be likened to the eyes of a boiled fish—this being due to fluorescence of the lens. Whether these and other appearances will be of value in radium treatment remains to be seen.

As before mentioned, several other researches have been begun, but it would serve no useful purpose either to mention them, or the incomplete results so far obtained. It may, however, be stated that application is being made for the loan of radium from the Medical Research Committee for research work.

RADIUM AND HYPERTRICHOSIS: OBSERVATIONS AND TECHNIQUE.

R. R. DU CASSE, M.D., Cincinnati, O.

For approximately the past ten years there have been many investigations made toward the development of a successful technique for the application of radium in the treatment of hypertrichosis. Those investigations while disappointing in many instances, have in others produced results seemingly justifying further efforts.

My experience with radium in this condition has extended over a period of three years and comprises a series of thirty cases. Due both to a lack of sufficient radium and to the extensive involvement in some of the individuals, it was necessary to average three treatments to a case. Furthermore, with each treatment I used two, and at times three placques, so that if one in itself was to be considered as a treatment, the total would reach over two hundred. And it is because of the general approval of the results attained on the part of those subjected to the treatment, that I am convinced of the value of radium therein.

No attempt was made to select subjects who might possibly prove more amenable to this form of treatment, with the exception of those individuals in whom the growth was so sparse as to admit of no other method than electrolysis.

Lanigo hairs were only encountered in association with the crause growth and were therefore subjected to treatment directed primarily to the latter. However, the fact that the finegrowth persisted in a few instances indicates the necessity of a slightly increased dosage for their permanent removal.

Too much stress cannot be laid upon the necessity of familiarity with the radium to be used for this purpose; such as regards radium, content, filtration, time consumed in the application; but particularly must there be uniformity in the application of the placque to the surfaces to be treated in the different individuals. In oder to make more emphatic the importance of the latter point, I recall an application made by an assistant over a period of seven hours, that produced but the faintest erythemia and no permanent depilation. Later, the same placque was reapplied for but five hours and a half, resulting in the usual reaction depilation. The one difference in the technique being in the pressure of the placque upon the underlying skin, and, in order to obtain this uniformity, I have since been making the application.

One of the chief objections to the use of radium in this capacity,

is the production of changes in pigmentation. This was noted in the majority of the applications, being peculiar in that there was an elimination of some of the pigment over the treated area and an apparent grouping of some of the border. But with the passage of time, there is a gradual tendency for this to become less marked, usually disappearing in the course of a few months. This pecularity is especially noted in those individuals of a markedly brunette type.

Telangectases, or the development of superficial vessels, have never followed the technique used, the principal factor in their avoidance, I attribute to the method of shielding.

Scarring and atrophy may be considered as identical in all but degree, the former being produced in ten of the applications and usually so slight as to be perceptable only on a more than casual inspection of the five patients in whom they were noted, these subquently returned for further applications. In order to cause a permanent depilation atrophy must be produced, and therefore accompanies all successful treatment. This, carried too far, results in scarring of various degree and cannot from our present knowledge be entirely eliminated. Nevertheless, it can be held within bounds, both as to degree and frequency and it evolves upon the patient as to whether they are sufficiently distressed to undergo this method of treatment.

Now and then, it occurs that a hair or few hairs may remain in the area treated, though a definite atrophy has been produced, and it may be of interest to note that upon introduction of an electrolysis needle, little resistance is met with until the needle has traveled down the follicle for a distance approximating an eighth of an inch, requiring some effort to penetrate same in order to reach the bulb. Indicating, perhaps, a more pronounced ability of the very superficial strata of the skin to regenerate after injury; that the subjacent layers receive a type of radiation more destructive in character, or that following the incomplete destruction of the follicle it is simply a manifestation of the difference in the reaction of the various strata to the radium.

One application was rather unusual in that it was followed by the formation of a furrow corresponding to the long axis of the placque; and in a second case there was a deepening of the natural lines of the skin.

Citicism may be directed toward the application of a flat to a slightly curved surface, but the fact is of material importance in but rare instances.

TECHNIQUE. I have endeavored to develop a technique by means of which a permanent depilation could be effected in one treatment. Where the surface involved is too extensive to be covered at one time, the remaining portion is taken care of by subsequent applications. In such an event it is well to allow a lapse of at least three weeks before making further applications, observing the reaction produced, and being guided thereby in subsequent dosage.

Early in the development of the technique I used four placques containing varying amounts of radium, finally demonstrating an ability to control most satisfactorily one which I will describe, and its method of use.

This placque has a flat applicating surface, is glazed, rectangular, being particularly appropriate for treating growths upon the upper lip, 3 cm. in length by 1.3 cm. in width, containing 5.27 mg. of radium.

A brass filter 0.3 mm. of the same dimension is placed next to

the glazed surface and both are then enclosed in a rubber tissue. This filtration, as stated previously, is deemed responsible for the lack of telangectases; but particularly does it enable one to give a greater dosage of the deeper rays through elimination of some of those more superficial in their action, at the same time providing for a more prolonged exposure to both the superficial as well as deep irradiations. Obviously a placque containing such a comparatively small amount of the element itself serves a similar purpose, as well as being less expensive.

By means of adhesive tape this is held in a position to the surface selected.

The length of time of exposure to the placque is usually five to five and three-quarter hours. The former time may be used safely upon the initial application, and subsequently increased if found necessary.

The reaction is manifested by an erythema appearing from the fifth to the tenth day, gradually increasing in intensity, then, as gradually subsiding and covering a period of four to five weeks. During the height of the reaction a slight desquamation may be noted, and rarely a definite crusting. Co-incident with this the growth disappears and where a few of the hairs may be noted, they are easily removed by forceps.

During this period the patient is cautioned to use only cotton or a very soft cloth and water for cleansing purposes; to not rub and especially to not disturb any crusting that may follow. At the same time they should be intrusted to report for observation at stated intervals.

From the foregoing, I can only conclude, notwithstanding our lack of absolute control, that radium may and does produce results to many individuals.

RADIJM AT THE NEW YORK STATE INSTITUTE FOR THE STUDY OF MALIGNANT DISEASE.

Dr. Harvey R. Gaylord, Director of the State Institute for the Study of Malignant Disease, at Buffalo, New York, and one of the Directors of the American Society for the Control of Cancer, has issued a statement through the latter organization, part of which is herewith given.

"The people of the State of New York will want to receive a statement on the stewardship of the purchase of 2 1/4 grams of radium for which an appropriation was made by the State, and announcement of which was made by Governor Smith a few days ago.

"I am very glad to take this opportunity both in the name of the Institute for the Study of Malignant Disease, the State and the American Society for the Control of Cancer which supported this purchase to say these words:

"The experiment in state ownership of a therapeutic agent, as exemplified in the purchase of this radium for social utility will have a far-reaching effect. This is a development of state medicine to which no one can object and Governor Smith deserves the thanks of the State for what he did."

"Any citizen of the United States may avail himself gratuitously after October 15th of treatment with the radium. Preference, however, will be given to citizens of New York State.

"The first gram is now in the vaults of the Institute at Buffalo and the appliances necessary for its use in the treatment of cancer are now

in course of construction. The engagement of a competent physicist to work with this radium is also announced. The radium we are using is an American product, mined in Colorado.

"The first purchase of radium by any State marks a step in the health activities of an American Commonwealth. Up to the present we have had no therapeutic agents, so expensive that they could not be afforded by the average practitioner. In the case of radium that condition arises. The unit for efficient use costs not less than $12,000 and represents 100 milligrams. A gram is worth $120,000. The greater the quantity in an installation the more efficient it is, and the less it costs per treatment. New York State has met this condition by purchasing an amount available for all its citizens.

"The value of radium has already arrived at a stage where States should make radium available for cancer treatment, gratuitously and beyond the realm of financial limitations. The advent of radium as a therapeutic measure is the most important forward step in the treatment of cancer.

"It is not surprising that when radium first made its appearance over-optimistic claims for its use and hope of its utility should have occurred. But that time is now past. Radium has been made available in smaller and larger amounts to all of the important centers of cancer research in this country, with the result that not alone has new knowledge of this agent been greatly advanced but the technique of its use as well as its limitations have been more definitely defined. The last six years have marked steady progress in its application, and means of more scientifically and more efficaciously employing it have been developed.

"The State Institute as a result of carefully controlled scientific experiment in its hospital felt that the time had come when the State of New York should logically provide an adequate amount of radium for the Institute on the basis that its value is so definitely demonstrated that it should be made available without cost to the citizens of the State and that the opportunities for research should now be extended along practical lines. The State Institute has had since 1914 an amount of radium sufficient for scientific study. Private philanthropy has given the Memorial Hospital in New York City a large amount of radium for scientific investigation and practical application for the past four years. The Cancer Research Commission of Harvard University has also had an adequate working supply. The advances made in these and other quarters has steadily strengthened the confidence in the use of this agent and all of these centers are now seeking means to increase their supply.

"The usefulness of radium in the treatment of neoplasms is still in its infancy, but there are already certain kinds of cancer in which its use offers advantages and the results obtained are an improvement upon any means we have heretofore possessed. It must, however, be remembered that our main reliance in the treatment of cancer is surgery but radium in combination with surgery, frequently greatly improves the prospective cure.

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